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Innovation and institutional ownership revisited: An empirical investigation with count data models

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SUMMARY

By discriminating between a lazy manager and a career concerns hypothesis, Aghion et al. (*The American Economic Review* 2013; **103**(1): 277–304) try to disentangle the link between innovation and institutional ownership. Citation-weighted patent counts are used as a proxy for innovation, which motivates the use of count data models. While a replication in a narrow sense confirms their empirical results which are mainly based on Poisson models, an analysis that extends the model framework by count data hurdle models does not yield the same findings. However, a remarkably stable positive correlation of citation-weighted patents and institutional ownership across all model specifications can be shown.

Keywords: innovation, institutional ownership, count data, hurdle model, replication.

1. INTRODUCTION

What sets the wheels of innovation in motion? And, what keeps them running? With a focus on the impact of the owners of publicly listed companies on innovation, Aghion et al. (2013) attract attention to institutional ownership, that comprises '... all investors in financial markets which are neither private households nor public institutions' (Menkhoff, 2002, p. 907).

Aghion et al. (2013) show empirically that institutional ownership is positively correlated with innovation. Additionally, the authors aim to disentangle the link between innovation, institutional ownership, and product market competition. This is achieved by an empirical discrimination between a lazy manager and a career concerns hypothesis. As the dependent variable innovation is mapped out through the use of future citation-weighted patent counts, the methodological approach employed by Aghion et al. (2013) is based on count data models. The authors estimate a Poisson model for the mean equation and employ standard errors clustered at either the firm level or a three-digit industry level.

Replication in a narrow sense confirms the empirical results obtained by Aghion et al. (2013). The software in use for the replication as well as for an extended analysis is R (R Core Team, 2013), instead of Stata, which is used by Aghion et al. (2013). Apart from small deviations, our replication attempt was successful. Nevertheless, we argue that the relevance of factors that contribute to the occurrence of innovative outcome differs between two distinct processes. Two aspects are of main interest in this context. The determinants that are necessary for a firm to be able to innovate, as well as the factors that keep an already innovating firm carrying out further innovations. Thus, we go one step furher and extend the analysis of Aghion et al. (2013) with hurdle models, which are useful to shed some light on potentially existing structural differences. Hurdle models are two-part models with a binary part that models the decision to innovate at all, and a count part that models ongoing innovation, respectively. This approach can be subsumed

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as a 'replication in a wider sense', and reveals that on the one hand, there is a stable positive correlation of innovation with institutional ownership, but on the other hand, the results are inconclusive regarding the career concerns and the lazy manager hypothesis. Indeed, there is some indication for a departure from the single-equation Poisson model, both from a statistical as well as from an economical perspective, as the Poisson model implicitly assumes one underlying process, for which the factors that drive innovation are the same. However, it might be the case that the first innovation is more difficult to achieve, especially compared to succeeding innovations. Thus, our contribution is the use of a more flexible modeling approach achieved through the utilization of count data hurdle models, instead of Poisson models. We argue that two-part hurdle models are, from a statistical as well as from an economical perspective, an interesting alternative that can provide us with new insights into the determinants that trigger innovative outcome.

In line with Aghion et al. (2013), most studies in the empirical literature that consider the relationship between (institutional) ownership structure and innovation (or R&D spendings) find a positive correlation[1]. To name a few examples, Baysinger et al. (1991) find a positive effect of institutional investors on R&D spendings (see also Hansen and Hill, 1991). Kochhar and David (1996) state that institutions are long-term oriented, and thus have a positive influence on firm innovation. Bushee (1998) finds that high institutional ownership is accompanied by a reluctance from managers to cut R&D after a decline in earnings. David et al. (2001) state that it is rather institutional investor activism that has a positive influence on R&D input. Summing up, a variety of components appear in the recent literature that can explain a positive effect of institutional investors on innovation.

The rest of the paper is structured as follows. Section 2 comprises the replication of the basic results obtained by Aghion et al. (2013) as well as an extension of their analysis by means of hurdle models, Section 3 contains the replication and extension of models with competition included as a further explanatory variable. Section 4 concludes.

2. BASIC MODELS: REPLICATION AND EXTENDED ANALYSIS

Future citation-weighted patent counts are used as a proxy for the dependent variable innovation, which motivates the use of count data models. As a starting point (and following Aghion et al., 2013), a log-link is implemented. In the spirit of a quasi-maximum likelihood approach, the Poisson model is employed for the mean equation along with clustered standard errors. The conditional expectation function is

$$\mathrm{E}(\mathrm{Cites}_{it} \mid \boldsymbol{x}_{it}, \gamma_i, \delta_t) = \exp(\boldsymbol{x}_{it}^\top \boldsymbol{\beta} + \gamma_i + \delta_t), \tag{1}$$

where Cites_{it} is the number of citation-weighted patent counts for company i in year t, the vector $\boldsymbol{x}_{it}$ contains all explanatory variables for firm i in year t in the model, γ_i are firm-specific fixed effects controls and δ_t are time dummy variables (Aghion et al., 2013, pp. 280–281). All models include institutional ownership, which is measured as the percentage of outstanding shares held by institutions, the capital to labor ratio as well as sales (in logs), time dummies and four-digit industry dummies as explanatory variables (Aghion et al., 2013). Some models additionally include the stock of R&D expenditures (in logs) and the presample mean-scaling estimator[2] developed by Blundell and Powell (2004).

Table I comprises the (successful) replication of Table 1 in Aghion et al. (2013, p. 283), with minor differences in the clustered standard errors. The outcomes show that the coefficient of institutional ownership is consistently positive and significant. However, the data show overdispersion as well as excess zeros. There are about 35.2% (accounting for 2,183 out of 6,208) firm-year observations with zero citation-weighted patents in the data. On one hand, the zeros can come from either the decision to keep potentially patentable discoveries in secrecy, or from the lack of

[1] An exception that 'confirms' the rule is Graves (1988), who finds a significant negative relationship between institutional ownership and R&D expenditures in the computer industry.

[2] To account for firm-specific fixed effects, the presample average of citation-weighted patents is included into the model (Aghion et al., 2013, p. 281).

Table I: Basic models – Replication

Dependent Variable	OLS ln(Cites) (1)	OLS ln(Cites) (2)	Poisson Cites (3)	Poisson Cites (4)	Poisson Cites (5)	NegBin Cites (6)	NegBin Cites (7)	NegBin Cites (8)
Institutional Owners	0.006**	0.005**	0.010***	0.008***	0.007**	0.009***	0.008***	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
ln(Capital/Labor)	0.433***	0.261**	0.483***	0.346*	0.440***	0.613***	0.343***	0.264***
	(0.094)	(0.085)	(0.136)	(0.165)	(0.132)	(0.093)	(0.096)	(0.072)
ln(Sales)	0.568***	0.310***	0.820***	0.349**	0.184**	0.493***	0.229	0.127*
	(0.037)	(0.045)	(0.042)	(0.117)	(0.063)	(0.141)	(0.147)	(0.054)
ln(R&D) Stock		0.337***		0.493***	0.009		0.448***	0.178***
		(0.040)		(0.140)	(0.107)		(0.094)	(0.035)
Fixed Effects Controls	No	No	No	No	Yes	No	No	Yes
Observations	4,025	4,025	6,208	6,208	6,208	6,208	6,208	6,208
AIC			744,624.834	667,665.617	446,655.330	48,159.657	47,345.215	46,058.249
BIC			745,614.672	668,668.922	447,672.102	49,156.229	48,355.254	47,081.756

This table is a replication of Table 1 in Aghion et al. (2013). Standard errors (in parentheses) are clustered at firm level. There are 803 different firms. Additionally, all regressions include time dummies for each year (with reference category 1991) as well as four-digit industry dummies. Fixed effects controls are included using the presample mean scaling estimator developed by Blundell and Powell (2004). Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

any patentable finding (see Crepon and Duguet, 1997), both of which resulting in a lack of any patents. On the other hand, the zeros can come from holding patents, but without citations. In the data analyzed, there are about 32.6% firm-year observations with zero patents in the data and 2.6% with patents but without citations. Summarizing the above, the amount of zeros in the dependent variable is higher than expected by the Poisson distribution, which casts doubt on the distributional assumption and suggests potentially different determinants driving the zero and non-zero citations.

Furthermore, overdispersion is a common characteristic of count data (in the field of economics), meaning that the conditional variance is higher than the conditional mean. The fraction $\frac{\text{Var(Cites)}}{\text{Mean(Cites)}} = 4,836.2$ reveals a substantial amount of overdispersion for citation-weighted patents (note that covariates are not taken into account here). A negative binomial model offers some remedy in such a situation (see e.g. Hausman et al., 1984). As a likelihood model, it does explicitly account for dispersion. Aghion et al. (2013) consider negative binomial models only in their basic models in Table 1 (columns 6, 7, and 8). However, it is worth pointing out that the negative binomial model does also not explain the high proportion of zero citations discussed above.

Finally, the Poisson model assumes independent occurrences over time (see e.g. Cameron and Trivedi, 1998) and it may also be the case that the first innovation (the first citation-weighted patent count) is especially hard to obtain in comparison to succeeding innovations, such that '…the innovation process is characterized by nonlinearities' (Crepon and Duguet, 1997, p. 360). For example, in case of the discovery of a seminal innovation, some further discoveries of minor importance can follow more easily (Crepon and Duguet, 1997).

In summary, these considerations concerning excess zeros, overdispersion, and potentially different determinants in the innovation process can be addressed by two-part hurdle models. Specifically, these consider the case that there are two different processes driving either the 'first innovation' (does a company own at least one citation-weighted patent) or the 'continuing innovation' (if a company has a positive number of citation weighted patents, how many of them does it possess) decision. Hurdle models allow to make this discrimination: Positive outcomes are observed if the zero hurdle is crossed and are modeled through a truncated (from the left) count model, whereas the probability to cross the hurdle is modeled via a censored binary model (see e.g. Cameron and Trivedi, 1998). Table II shows the same models as Table I, but using negative binomial hurdle models instead of the (single-equation) Poisson models. As in the original analysis standard errors are clustered at the firm level.

The results indicate that the coefficient of institutional ownership is for most of the estimated hurdle models positive and significant. The only exception is the count part of the Hurdle NegBin (3) model, where the coefficient of institutional ownership is no longer significant. Quantitatively, a dampening of the coefficient of institutional ownership in the count part of the model can be observed, the more variables are included into the model. In the binary part of the model, the

Table II: Basic – Hurdle models

Dependent Variable	Hurdle NegBin (1) Cites		Hurdle NegBin (2) Cites		Hurdle NegBin (3) Cites	
	count	zero	count	zero	count	zero
Institutional Owners	0.006**	0.010***	0.005**	0.011***	0.003·	0.010***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
ln(Capital/Labor)	0.550***	0.409***	0.318***	0.254*	0.253***	0.258**
	(0.099)	(0.111)	(0.084)	(0.103)	(0.070)	(0.100)
ln(Sales)	0.440***	0.538***	0.200***	0.317***	0.118***	0.199***
	(0.047)	(0.048)	(0.058)	(0.050)	(0.036)	(0.048)
ln(R&D) Stock			0.407***	0.304***	0.155***	0.114***
			(0.042)	(0.036)	(0.031)	(0.033)
Fixed Effects Controls	No		No		Yes	
Observations	6,208		6,208		6,208	
AIC	47,453.699		46,567.227		44,970.293	
BIC	49,440.109		48,580.572		47,010.572	

Standard errors (in parentheses) are clustered by firm. There are 803 different firms. Additionally, all regressions include time dummies for each year (with reference category 1991) as well as four-digit industry dummies. Fixed effects controls are included using the presample mean-scaling estimator developed by Blundell and Powell (2004). The zero part is a binomial with logit link. The count part is a truncated negative binomial. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

coefficient of institutional ownership is quite stable. For most of the other explanatory variables, a dampening of the coefficients in both parts of the model can be observed the more variables are included into the model.

3. COMPETITION MODELS: CAREER CONCERNS VS. LAZY MANAGER

Two hypotheses are considered by Aghion et al. (2013), the lazy manager hypothesis and the career concerns hypothesis (which is preferred by Aghion et al., 2013). Both hypotheses predict a positive relationship between institutional ownership and innovation, but they differ with regard to product market competition.

The lazy manager approach is based on 'quiet life' models developed by Bertrand and Mullainathan (2003). It is assumed that managers prefer a quiet life, and want to keep the status quo, as '. . . he [the average manager] seems to avoid creating new plants as much as he avoids destroying old ones' (Bertrand and Mullainathan, 2003, p. 1072). If competition is high, there is no need for intensified monitoring, because 'competiton is a source of discipline.' (Hart, 1983, p. 366). Hence, the lazy manager approach implies that institutions and competition are substitutes (Aghion et al., 2013, p. 292).

The career concerns hypothesis pays closer attention to the managerial labor market. In a seminal paper, Fama (1980) investigates how pressure imposed by managerial labor markets can discipline managers. As a manager's talent is at least partially unknown to other market participants '. . . investment decisions become tests that provide information about talent. Perceptions about talent, in turn, determine the manager's future opportunity wage and this is what makes investments risky from the manager's perspective even if income is not explicitly tied to profits' (Holmstrom, 1999, p. 178). Institutional investors insure the manager against career risks, as they collect independent information (the crucial point here is the assumption of better monitoring abilities by institutional investors) and assess the ability of a manager based on that information, and not solely based on revenue realization (Aghion et al., 2013). Thus, if competition is high, the positive effect of institutional investors on innovation should be stronger. According to the career concerns hypothesis, institutions and competition are complements (Aghion et al., 2013, p. 292).

Table III contains the replication of a selection of Poisson models[3] conducted by Aghion et al. (2013, p. 293), with product market competition included as a further explanatory variable. Column 1 displays a Poisson model with an interaction between product market competiton and

[3]The replication of all models from Table 2 in Aghion et al. (2013, p. 293) was successful. For the sake of brevity, only a selection of these models is presented here.

Table III: Competition Poisson models – Replication

	Poisson	Poisson	Poisson
Competition over time	Varies	Constant	Constant
Sample	Pooled	High Comp.	Low Comp.
Dependent Variable	Cites	Cites	Cites
	(1)	(2)	(3)
Institutional Owners	−0.064*	0.009***	0.000
	(0.030)	(0.001)	(0.003)
ln(Capital/Labor)	0.452***	0.564***	0.206*
	(0.141)	(0.115)	(0.081)
ln(Sales)	0.189*	0.267***	0.086
	(0.075)	(0.070)	(0.063)
ln(R&D) Stock	−0.001	−0.063	0.047
	(0.084)	(0.107)	(0.088)
Competition	−3.694		
	(3.330)		
Institutional Owners× Competition	0.082*		
	(0.035)		
Fixed Effects Controls	Yes	Yes	Yes
Observations	6,208	3,125	3,083
AIC	444,893.694	298,559.057	131,075.768
BIC	445,923.934	299,000.502	131,636.898

This table shows the replication of a number of models from Table 2 in Aghion et al. (2013). All models are Poisson regression models. Standard errors (in parentheses) are clustered at three-digit industry level. There are 803 different firms. Additionally, all regressions include time dummies for each year (with reference category 1991) as well as four-digit industry dummies. Fixed effects controls are included using the presample mean-scaling estimator developed by Blundell and Powell (2004). An industry is classified as one with high competition if it is above the median of the $1 -$ Lerner index. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

institutional ownership. As the coefficient has a positive sign and is significant, this is indicative for the career concerns hypothesis and against the lazy manager hypothesis. Columns 2 and 3 of Table III show two Poisson models based on a high and low competition sample, respectively. The coefficient of institutional ownership is positive and significant for the model based on the high competition sample, whereas it is zero and insignificant for the low competition model. Again, this result delivers evidence for the career concerns hypothesis.

To show that the Poisson model with interaction term provides quantitatively nearly the same conclusions as the two Poisson models with the data split into high vs. low product market competition, we use the following illustration. As a rough guideline, assume a value of 0.9 for high competition, and a value of 0.8 for low competition[4] For high competition, the coefficient of institutional ownership (Table III, column 1) is $-0.064 + 0.9 \cdot 0.082 = 0.0098$, whereas the coefficient has a value of $-0.064 + 0.8 \cdot 0.082 = 0.0016$ for low competition. These coefficients are very close to those in the models based on the high- and low- competition sample in Table III, columns 2 and 3, with values of 0.009 and 0.000. Thus, with regard to the interpretation of the institutional ownership coefficient, there is hardly any difference between a modeling strategy based on an 'interaction view' and a 'sub-sample view'.

Table IV contains the same models as Table III, but again hurdle models are employed, instead of Poisson models. If both zero and non-zero citations were driven by the same determinants, then both parts of the hurdle model should deliver similar results as the Poisson model. However, it is observed that the clear preference for the career concerns hypothesis and against the lazy manager hypothesis heavily depends on the model framework. When hurdle models are used, the empirical results do not show such a clear picture. Even more, there is some evidence that neither the lazy manager hypothesis nor the career concerns hypothesis can satisfactorily explain the mechanisms at work.

The coefficient of the interaction term of competition times the share of institutional owners (Hurdle NegBin (1)) is negative and significant (at the 5 percent significance level) in the zero part

[4]The first and third quartile of product market competition constant over time are 0.83 and 0.89, respectively. For the sake of simplicity, 0.8 and 0.9 are used in the illustration leading to qualitatively the same interpretation.

Table IV: Competition – Hurdle models

	Hurdle NegBin (1)		Hurdle NegBin (2)		Hurdle NegBin (3)	
Competition over time	Varies		Constant		Constant	
Sample	Pooled		High Comp.		Low Comp.	
Dependent Variable	Cites		Cites		Cites	
	count	zero	count	zero	count	zero
Institutional Owners	−0.014	0.084*	0.003***	0.005·	0.002	0.013***
	(0.020)	(0.034)	(0.001)	(0.003)	(0.002)	(0.003)
ln(Capital/Labor)	0.252***	0.265**	0.239***	0.346**	0.229**	0.223·
	(0.051)	(0.085)	(0.049)	(0.130)	(0.086)	(0.115)
ln(Sales)	0.117***	0.199***	0.111·	0.308***	0.118***	0.130**
	(0.031)	(0.061)	(0.060)	(0.081)	(0.030)	(0.061)
ln(R&D) Stock	0.155**	0.115*	0.225**	0.095	0.081·	0.128***
	(0.051)	(0.054)	(0.085)	(0.107)	(0.046)	(0.052)
Competition	−1.970	1.818				
	(2.883)	(4.269)				
Competition×	0.019	−0.087*				
Institutional Owners	(0.023)	(0.040)				
Fixed Effects Controls	Yes		Yes		Yes	
Observations	6,208		3,125		3,083	
AIC	44,973.690		24,328.266		20,584.206	
BIC	47,040.904		25,217.203		21,712.500	

Standard errors (in parentheses) are clustered at three-digit industry level. There are 803 different firms. Additionally, all regressions include time dummies for each year (with reference category 1991) as well as four-digit industry dummies. Fixed effects controls are included using the presample mean-scaling estimator developed by Blundell and Powell (2004). The zero part is a binomial with logit link. The count part is a truncated negative binomial. An industry is classified as one with high competition if it is above the median of the $1 -$ Lerner index. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

of the model, whereas it is positive but not significant in the count part of the model. The fact that the interaction term in the zero part of the model has a negative sign is puzzling, as neither the lazy manager hypothesis nor the career concerns hypothesis can provide an adequate explanation for this result. The career concerns hypothesis requires that the coefficient of the interaction term is positive and signicant, because then the assumption that competition and innovation are complements is fulfilled. However, the influence of institutional ownership is different in the two parts of the model, which can also be observed in the models with the sample split into high and low competition. In the high competition sample, the coefficient of institutional ownership is positive in both parts of the model, but only in the count part significant (Hurdle NegBin (2)), whereas the coefficient is positive in both parts of the model for the low competition sample, too, but only significant in the zero part of the model (Hurdle NegBin (3)). Furthermore, a similar numerical illustration as shown above also applies to hurdle models[5].

One possible interpretation is that with a low level of (product market) competition in a market, the results indicate a positive influence of institutional investors on the decision to conduct the 'first innovation', but only a very small effect on the decision to engage in 'continuing innovations'. With a high level of (product market) competition in a market, the effect of institutional investors refers more to 'continuing innovation', rather than to 'first innovation'. Summing up, the influence of institutional ownership on innovation is in both parts of the models positive, but not in every part significant. This result can be seen as an image with a higher resolution than is possible to generate within the Poisson approach.

In a nutshell, the discrimination between the career concerns hypothesis on the one hand and the lazy manager hypothesis on the other hand based on Poisson models does not produce the

[5]Using the same numbers as before, the coefficient of institutional ownership (Table IV, count part of Hurdle NegBin (1)) is $-0.014 + 0.9 \cdot 0.019 = 0.0031$ for the high competition sample and $-0.014 + 0.8 \cdot 0.019 = 0.0012$ for the low competition sample, which is again approximately equal to the coefficients of the count parts in Table IV, Hurdle NegBin (2) and Hurdle NegBin (3), with values of 0.003 and 0.002. For the binary part of the models, the coefficient is $0.084 - 0.9 \cdot 0.087 = 0.0057$ and $0.084 - 0.8 \cdot 0.087 = 0.0144$ for the high- and low competition sample, respectively. The coefficients of institutional ownership in the binary part in Table IV, Hurdle NegBin (2) and Hurdle NegBin (3) are 0.005 and 0.013. Equivalent to the illustration based on Poisson models, hardly any differences should be found between an 'interaction view' and a 'sub-sample view'.

same results as a modeling strategy based on a hurdle (or even a negative binomial) model.

As a consequence, this raises the issue whether the conclusions drawn in the Aghion et al. (2013) paper are robust. Of course, we most certainly can not stand here and say that the use of hurdle models is the most suitable solution. In the alternative, should it be held that the Poisson model would be the most appropriate model, the hurdle model should deliver similar results. The results which we have achieved do not point in that direction, though. Instead, we find that innovation is differently affected by institutional owners in the two parts of a hurdle model. Any conclusion that shows preference for the career concerns hypothesis and against the lazy manager hypothesis can not be drawn in such a setting.

4. CONCLUSION

Based on a successful replication in a narrow sense of (parts of) the Aghion et al. (2013) paper, a refinement of the modeling strategy reveals differences with regard to the sign and significance of the coefficients of interest, and hence also to the interpretation. The results obtained from an extended analysis with negative binomial hurdle models differ materially from the outcomes of the single-equation Poisson approach carried out by Aghion et al. (2013). While the Poisson-based model delivers a clear indication for the career concerns hypothesis and against the lazy manager hypothesis, there is evidence for a deviation from the Poisson model. Both economical as well as statistical considerations suggest that different determinants may drive zero and non-zero patent citations. If a single set of determinants were sufficient for describing the underlying innovation processes, then both parts of the hurdle model should lead to estimates that are similar to the coefficients from the Poisson equation. However, both the sign and the significance of the coefficients of interest change when employing the hurdle model (using the same type of clustered standard errors as in the Poisson case), providing evidence for differing determinants.

From an economic perspective, this is a difference in determinants of ‘first innovation’ and ‘continuing innovation’, respectively. If it is the case that the first innovation (the first citation-weighted patent count) is especially hard to obtain in comparison to succeeding innovations, hurdle models offer a useful way which allows for a distinction to be made between these two processes. The rationale behind this is the notion of nonlinearities in the innovation process (Crepon and Duguet, 1997, p. 360). Then, the processses that drive innovative outcome might themselve be affected by a number of different driving factors.

The empirical findings resulting from the extended analysis concerning the discrimination between the lazy manager hypothesis and the career concerns hypothesis indicate that neither hypothesis is completely satisfactory. The unambiguous, interpretable picture arising out of the analysis of Aghion et al. (2013) can not be fully confirmed when hurdle models are used. Nevertheless, there is some evidence for a remarkably stable positive correlation of citation-weighted patents and institutional ownership across specifications.

5. COMPUTATIONAL DETAILS

The results of the empirical analysis are obtained using R 3.1.0 (R Core Team, 2013) with the packages **AER** 1.2-1, **countreg** 0.1-1, **foreign** 0.8-61, **MASS** 7.3-33 (Venables and Ripley, 2002), **pscl** 1.04.4 (Zeileis et al., 2008) especially for the function `hurdle()`, and **sandwich** 2.3-0 (Zeileis, 2006).

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Innovation and institutional ownership revisited: An empirical investigation with count data models

Abstract
By discriminating between a lazy manager and a career concerns hypothesis, Aghion et al. (The American Economic Review 2013, 103(1), 277-304) try to disentangle the link between innovation and institutional ownership. Citation-weighted patent counts are used as a proxy for innovation, which motivates the use of count data models. While a replication in a narrow sense confirms their empirical results which are mainly based on Poisson models, an analysis that extends the model framework by count data hurdle models does not yield the same findings. However, a remarkably stable positive correlation of citation-weighted patents and institutional ownership across all model specifications can be shown.

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